```
clear
% U5.3
% A is ethyleneoxide
% B is CO2/N2 mixture
% C is water

yin = 0.03;       % mol-A/mol
Yin = yin/(1-yin) % mol-A/mol-B
```

```
Yin = 0.0309
```

```
HETP = 0.5; % m
p = 2e6; % Pa
t = 30+273; % K
phi = 0.65; % YA = phi*XA (linear equilibrium given)

xin = 0.1e-2; % mol-A/mol
Xin = xin/(1-xin) % mol-A/mol-C
```

```
Xin = 0.0010
```

```


yield = 0.95;
nGin = 45; % kmol/h
% 1 mol B per 1 mol C
vGin = 0.02; % m/s
```

Column diameter

```
nB = nGin/(Yin+1) % kmol/h
```

```
nB = 43.6500
```

```
VGin = (nGin*1000/3600)*8.314*t/p % m3/s
```

```
VGin = 0.0157
```

```
S = VGin/vGin % m2
```

```
S = 0.7872
```

```
D = sqrt(4*S/pi) % m [1m expected according results]
```

```
D = 1.0012
```

Minimum consumption of the solvent

```
% equilibrium and working lines
Yout = Yin*(1-yield)
```

```
Yout = 0.0015
```

```
Xeq = linspace(0,Yin/phi,100);
```

```
Yeq = phi*Xeq
```

```
Yeq = 1×100
         0    0.0003    0.0006    0.0009    0.0012    0.0016    0.0019    0.0022 ···
```

```
% actual solvent consumption
nC = nB % kmol/h (given 1:1 nB:nC ratio)
```

```
nC = 43.6500
```

```
Xout = Xin + nB/nC*(Yin-Yout)
```

```
Xout = 0.0304
```

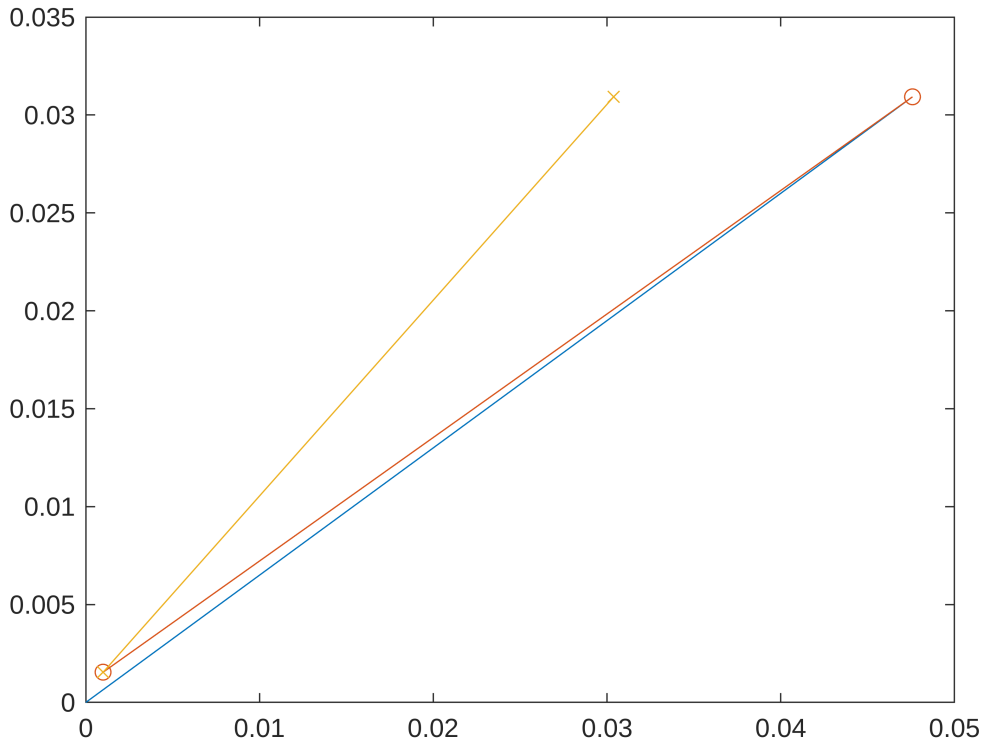
```
% minimum solvent consumption
MXout = Yin/phi % equilibrium is a line (no need to guess visually)
```

```
MXout = 0.0476
```

```
nCmin = nB*(Yin-Yout)/(MXout-Xin) % kmol/h
```

```
nCmin = 27.5331
```

```
% let us make a plot anyway, just for the illustration...
plot(Xeq,Yeq,'-',[Xin MXout],[Yout Yin],'-o',[Xin Xout],[Yout Yin],'-x')
```




```
%legend('equilibrium','w.line for nBmin', 'w.line for nB')
```

```
% answer
ratio = nC / nCmin % [Expected 1.6 according to results]
```

```
ratio = 1.5854
```

Column height

```
% find number of theoretical stages graphicaly, or numerically (linear equilibrium)
xi = nC/(phi*nB) % absorption factor (verify it is not 1!)
```

```
xi = 1.5385
```

```
N = log((Yin/phi-Xout)/(Yout/phi-Xin)) / log(xi)
```

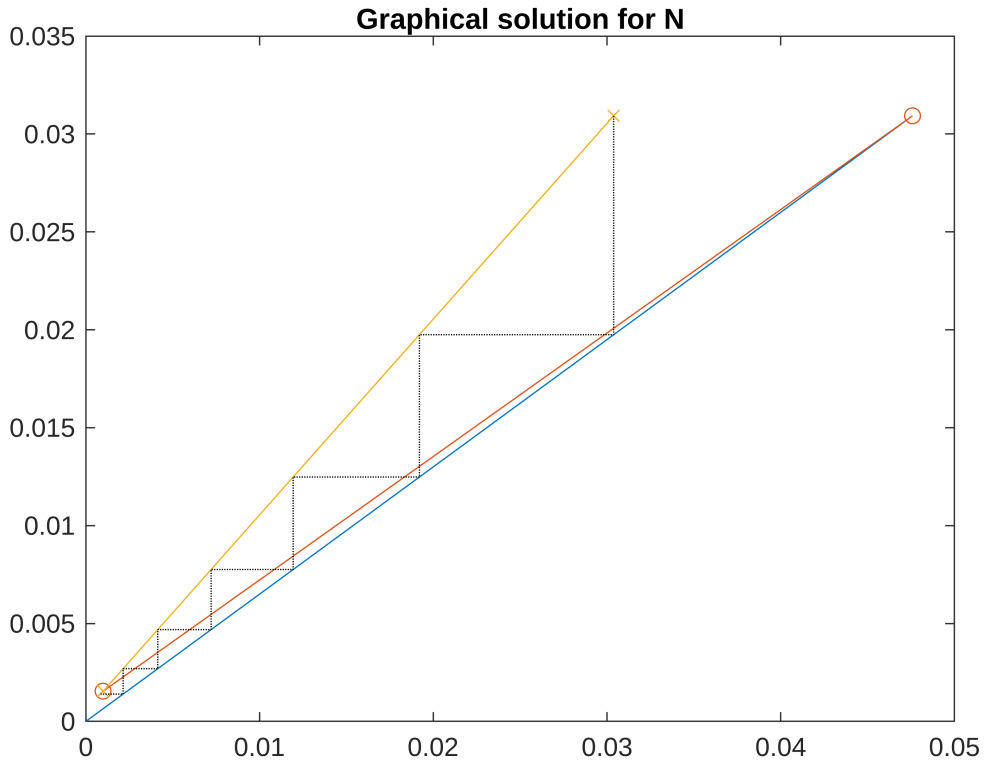
```
N = 5.8595
```

```
H = N*HETP % m [Expected 3 m according to results]
```

```
H = 2.9297
```

```

% YOU CAN SKIP THESE LINES
% I want to add the actual steps to the plot
XX = [Xout];
YY = [Yin];
for i=1:round(N)
    % go down to the equilibrium
    XX = [XX, XX(end)];
    YY = [YY, XX(end)*phi];
    % go left to the working line
    XX = [XX, Xin+nB/nC*(YY(end)-Yout)];
    YY = [YY, YY(end)];
end
hold on
plot (XX, YY, ['k:'])
hold off
title("Graphical solution for N")
```




```
% ...END OF LINES FOR THE PLOT
```

Results: Column height is 2.93 m (reported result 3 m). Column diameter is 1 m (reported result 1). Ratio nC/nCmin is 1.6, (reported result is 1.6)